



# THE Observer

Noaa's National Geodetic Survey

July - September 2003

## NGS Documents Hurricane Isabel's Destruction of North Carolina Coast

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After Hurricane Isabel swept through the North Carolina coast on September 19, NGS spent the weekend taking photos of the changed coastline. The Category 2 storm created a new inlet near Cape Hatteras Village.

In order to capture the extent of the shoreline alteration, NGS mounted a digital camera on the bottom of a NOAA Twin Otter aircraft. The camera, an Applanix-Emerge Digital Sensor System, has a built-in Global Positioning System,

allowing each image to be georeferenced. The images were taken at an altitude of 7,500 feet.

The NOAA aircraft flew multiple flights over the weekend and took more than 600 images of the North Carolina Coast. Several North Carolina state agencies, including its Emergency Management Agency and Department of Natural Resources, requested these detailed photos. The images were produced

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# Field Work for the Federal Base Network Complete



-By Kathy Milbert

At 12:30 p.m. on July 24, NGS completed field work for the Federal Base Network survey project. Started in 1997 and spanning the continental United States, this survey collected data to refine the accuracy of coordinates in the National Spatial Reference System.

The purpose of the project was to complete the horizontal and ellipsoidal height components of FBN stations in order to ensure 2-centimeter local accuracy in the horizontal component, as well as 2-centimeter accuracy of the ellipsoid heights. The following is a brief history of the effort:

In the late 1980's, NGS began a program to establish a High Accuracy Reference Network (HARN) across the United States. It was implemented on a state-by-state basis, using the best available GPS technologies and procedures at that time. Coordinates determined by Very Long Baseline Interferometry (VLBI) served as control for the first HARN surveys.

In the mid-1990's the establishment of the Continuously Operating

Reference Station (CORS) Network provided an even more accurate set of coordinates. In 1996 an A Order Survey of the Eastern Strain Network allowed us to evaluate the HARN relative to the CORS nationwide. Several large positional errors were traced to the original Eastern Strain Network Project (1987-1990) which served as a foundation of control for the HARN. Subsequently, a readjustment of coordinates from

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## Field Work (Cont.)

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the affected HARNs resolved these large discrepancies in the horizontal component.

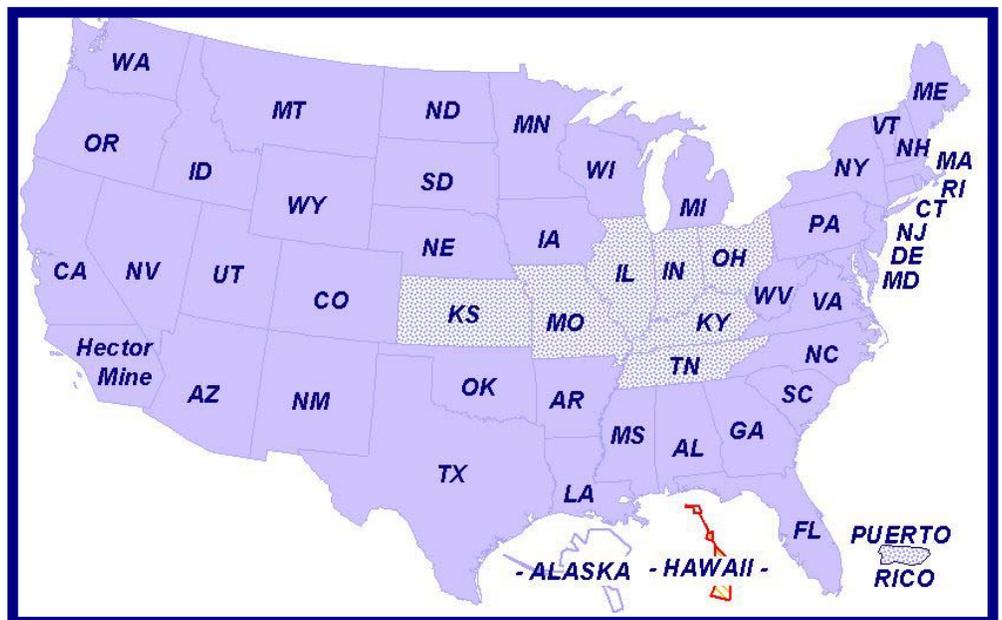
However, large discrepancies between the HARN and CORS in the vertical component were not so easily resolved. Our application of GPS technology in the early 1990's was not capable of producing highly accurate ellipsoid heights. As later HARNs and GPS projects tied into the early HARNs, the ellipsoid height inconsistencies in the network became more noticeable. The FBN re-observation campaign was designed in large part to resolve this issue.

In each FBN/CBN survey, ties were made between the CORS and HARN stations, and the latest Pages software was used to reduce the data. By comparing an adjustment that constrained the CORS coordinates with the published HARN coordinates, it was possible

to determine the magnitude of the coordinate discontinuity between the HARN and CORS in each state.

The NGS Executive Steering Committee set a 5

maintain consistency between the readjusted FBN coordinates and the previously published GPS coordinates, subsequent statewide GPS readjustments using data from the original HARNs and GPS projects are performed.



*July 2003 status map of the completed FBN*

cm tolerance to determine whether or not a readjustment of coordinates should be performed. For most states (except Minnesota and Georgia) it has been necessary to readjust the ellipsoid heights. In addition, several states required the readjustment of horizontal positions as well. To

Once all data from the FBN/CBN surveys are reduced, adjusted, and loaded into the integrated database, we will have a highly accurate GPS dataset with strong ties to the CORS network across the contiguous United States. These data can be used as a foundation for a National Readjustment for the establishment of network and local accuracies throughout the country.

## NGS Measures Subsidence Rates in Louisiana



*GPS Observations at an old plantation. Photo credit: Cliff Mugnier, LSU.*

-By Nikki Case

On June 11-20, NGS measured the road and levees along Highway 23 in Plaquemines Parish, Louisiana. The survey will help to determine how much Highway 23 has subsided, or sunk. Last fall, NOAA and the NOAA-funded Louisiana Spatial Reference Center (LSRC), located at Louisiana State University, measured the subsidence rate of Highway 1 in Louisiana; the data from this study indicate that portions of coastal Louisiana could lose up to one foot of elevation over the next decade.

NGS, in collaboration with the U.S. Army Corps of Engineers, the Department of Transportation and Development, Louisiana State University, the Louisiana State Police, and the Plaquemines Parish

Government, held static Global Positioning System observations, tying a network of benchmarks along the Highway to the National Water Level Observation Network (NWLON) station at Grand Isle.

As the only long-term tide and water level station in Louisiana run by the Center for Operational Oceanographic Products and Services (CO-OPS), this station measures the water levels relative to a specific vertical datum. By making survey ties between

benchmarks at the Grand Isle tide station to the dial gage and the geodetic datum, and then subtracting out the estimated rates of global sea level rise, the rate of change in elevations can be found.

After the data are processed, extremely accurate information on the elevation of Highway 23 and the rate of its subsidence will be available. This means that officials can better predict when roads will flood and when evacuation needs to occur.

For a region like Plaquemines Parish, up-to-date information about water and land levels is vital for the safety of residents. The Parish, located at the most southeastern tip of Louisiana, is surrounded on three sides by the Gulf of Mexico and divided by the Mississippi River. Highway 23 is the main hurricane evacuation route for the region, and flooding

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## NGS Measures Subsidence (Cont.)

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may mean loss of property, industry, and life if appropriate emergency preparedness plans are not put into place.

Roy Dokka, director of LSRC, points out that with the estimates, simple calculation shows when places like Plaquemines Parish are going to be at sea level. “By putting this data in a reference frame, you can compare present-day elevations with past elevations and calculate the rate of change. And some areas locally are sinking faster than others.”

Benny Rouselle, Plaquemines Parish President, comments, “We appreciate the survey work that has been done in the Parish; the information is very valuable in understanding when we stand today with the elevations of our levees and roadway system.”



*Davy Crockett with GPS equipment.*



*Kendall Fancher and Mark Eckl take GPS observations along Highway 23.*

## Restoration at Fort McHenry



*NGS works with the contractor for the MPA to determine depths of marsh channel at Fort McHenry.*

On July 14, NGS co-sponsored a field trip to Fort McHenry for Coastal Zone '03 participants. Working with the Center for Operational Oceanographic Products and Services (CO-OPS) and the Office of Coast Survey (OCS), NGS showed how geodesy can be used in marsh restoration efforts in the upper Chesapeake Bay.

Last fall, NGS conducted several kinematic GPS surveys of a wetland adjacent to Fort McHenry. The wetland was originally

created in 1982 as a mitigation credit for the construction of the Fort McHenry Interstate 95 tunnels in Maryland. Three small culverts in the wetland allowed for exchange between tidal and harbor waters.

Now, the culverts are almost completely cut off

from silt build up; because the wetland is a salt marsh, its survival depends on salt water. Restoration efforts plan to promote regular, natural tidal flooding to the site, control debris accumulation, and enhance its habitat value to plant and animal species. This project was initiated by a Memorandum of Agreement with the Maryland Port Administration (MPA).

NGS and CO-OPS plan to use the geodetic data derived from the GPS surveys in conjunction with CO-OPS' high water analyses and long-term sea level assessments on data from its long term National Water Level Observation Network (NWLON) station at the Fort. A preliminary digital elevation model (DEM) was given to MPA's contractor, who will use the data to design the new wetlands site.

When the wetland is restored, CO-OPS will install a new tide station at

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## Restoration (Cont.)

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the site and NGS will conduct another geodetic survey. The National Aquarium in Baltimore will use these data to determine how long and how much the marsh vegetation can be flooded by salt water.

At Coastal Zone '03, field trip participants observed how NGS uses GPS to gather elevation data, saw CO-OPS' NWLON station at Baltimore, and took a short boat ride on the NOAA (S/V) BAY HYDROGRAPHER to experience sample hydrographic surveying off the Fort McHenry marsh site.

The National Aquarium in Baltimore also showed field trip participants a model wetland, part of the Chesapeake Bay Wetland Nursery Program. The saltwater pond, 16 x 16 feet and constructed of a wood frame and plastic sheeting, is set up near the Fort McHenry wetlands; the

Aquarium has facilitated the construction of similar ponds in 2002 at two Baltimore City schools. In 2003, the program added three more regional schools.

The students construct the pond on site at their respective school and plant a salt marsh grass, *Spartina alterniflora*, or smooth cordgrass. The plants are harvested after a few months; students then plant their plants at Aquarium-sponsored restoration sites. In the future, the Aquarium will work on adding fish to the program.

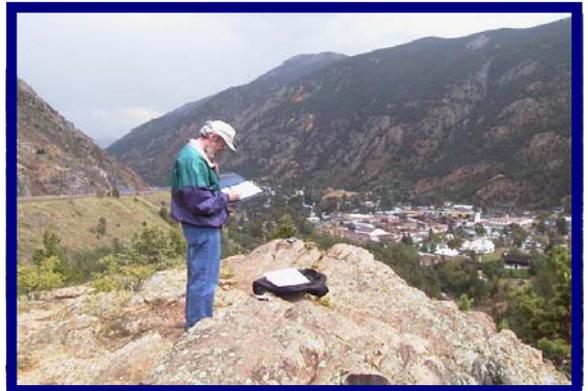
For more information about this program, contact [aashley@aquaria.org](mailto:aashley@aquaria.org).

For information about NGS involvement, contact [Joe.Evjen@noaa.gov](mailto:Joe.Evjen@noaa.gov).

For CO-OPS information, contact [Kristen.Tronvig@noaa.gov](mailto:Kristen.Tronvig@noaa.gov).

For OCS information, contact [Holly.A.Dehart@noaa.gov](mailto:Holly.A.Dehart@noaa.gov).

## NGS Begins Research in the Rockies



*Steve Frakes takes reconnaissance notes at Station Pay Dirt in CO.*

On August 13, NGS began a research and development project in the Rocky Mountains of Colorado. Joe Evjen and Steve Frakes conducted a reconnaissance of permanent markers along 73 miles of Interstate 70, from Golden to Vail Pass. They made a list of recommended markers to locate and will give this to the contractor who will be working on the project.

The Colorado Department of Transportation surveyed these marks last year using more conventional spirit leveling techniques. After the new data are collected, the elevations from the new project will be compared to those from last year's work. The analysis of the data will help NGS improve GPS height survey techniques.

## Hurricane Isabel (Cont.)

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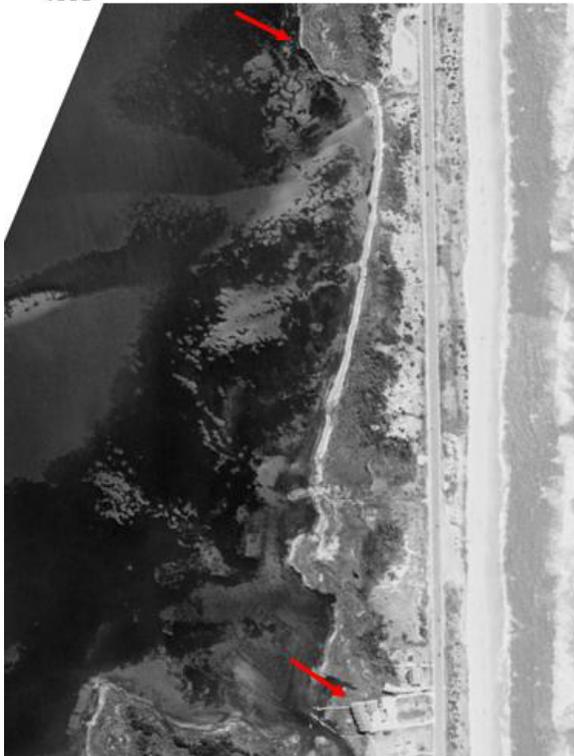
in about two hours after the aircraft landed.

The camera will continue to be used for research and development of technology for use in NOAA programs like shoreline mapping.



### Hurricane Isabel Damage Assessment

1998



19 Sept 2003



**Cape Hatteras National Seashore, North of Hatteras Village, NC.**